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Memorandum

To: *Rebecca Thomas, David Berry, Deborah McKean, Dania Zinner (EPA, Region 8)*

From: *Lynn Woodbury, Teddy Marcum*

Date: *April 26, 2013*

Subject: *OU6 Outdoor ABS Supplemental TEM Analysis Recommendations*

INTRODUCTION AND PURPOSE

In 2008, an outdoor activity-based sampling (ABS) study was conducted for Operable Unit 6 (OU6) of the Libby Asbestos Superfund Site. These ABS data will be used in risk calculations in the human health risk assessment (HHRA) to evaluate potential inhalation exposures to Libby amphibole (LA) asbestos in air at OU6. Prior to 2011, ABS studies were designed to meet analytical requirements based on the inhalation unit risk (IUR) for asbestos provided in the Asbestos Framework document (EPA 2008). More recently, the U.S. Environmental Protection Agency (EPA) has proposed new cancer and non-cancer toxicity values that are specific to LA[1]. These are draft values that are currently undergoing review. Because the proposed LA-specific non-cancer reference concentration (RfC) is very low, the target analytical sensitivity (TAS) requirements will be much lower to support reliable risk calculations than those originally specified in the 2008 outdoor ABS study for OU6.

Per your request, we have re-evaluated the analytical sensitivities achieved for the outdoor ABS air datasets available for OU6 to determine if they are adequate to support risk management decision making with respect to the LA-specific RfC. This technical memorandum summarizes the results of this evaluation and makes recommendations as to the number and types of supplemental analyses that can be performed to improve these datasets.

DATASET SUMMARY

The 2008 outdoor ABS study for OU6 was conducted in basic accordance with the *Rail Maintenance Public Receptor Activity-Based Sampling and Analysis Plan* (ENSR/AECOM 2008). The ABS study was designed to evaluate potential exposures to Burlington Northern Santa Fe (BNSF) workers along the railway maintenance of way (MOW) and the general public. Personal air samples, stationary air samples, and soil samples were collected during the 7-day ABS event conducted from September 17 to 25, 2008.

[1] http://www.epa.gov/region8/superfund/libby/2_ToxicityRiskAssessment_20110503.pdf

All samples were analyzed for LA. Specific sampling locations differed each day, depending upon where planned rail maintenance activities were being conducted, and included locations at a distance of 7.5 to 12 miles from Libby and from 1 to 3.6 miles from Troy.

Two types of public exposure scenarios were planned: on-looker trespassers and pedestrian trespassers. For the on-looker trespasser scenario, air samples were to represent potential exposures when railway maintenance activities were taking place. For the pedestrian trespasser scenario, air samples were to represent potential exposures when railway maintenance activities were not occurring. However, due to manpower limitations during the actual ABS, the pedestrian trespasser spent most of the sampling period in areas where maintenance activities were occurring; thus, the two trespasser scenarios were essentially the same. A total of 7 on-looker trespasser personal ABS air samples and 14 pedestrian trespasser personal ABS air samples were collected.

The worker scenario simulated two types of railroad workers: a laborer performing duties on the track as part of larger group of workers and worker operating machinery with an open air cab. A total of 14 worker personal ABS air samples were collected (7 samples per worker type). In addition, two stationary air samples were collected from each side of the track undergoing maintenance activities during the ABS event. A total of 23 stationary air samples were collected.

All samples were analyzed for asbestos by transmission electron microscopy (TEM) utilizing International Organization for Standardization (ISO) Method 10312:1995(E) counting and recording rules (ISO 1995). The target analytical sensitivity (TAS) calculated in the SAP (ENSR/AECOM 2008) was derived based on a BNSF worker exposure scenario and utilizing the asbestos IUR (EPA 2008). The TAS specified in the SAP was 0.001 cc^{-1}. No LA structures were observed in any collected air sample. However, more than half of all air samples collected during this ABS study did not achieve the TAS.

Note: Several deviations from the SAP occurred during this study due to manpower availability and field conditions. Deviations included changes in sample durations, adjustment of air pump flows, trains passing through the maintenance area during ABS, and rainfall occurring on one ABS sampling day. CDM Smith also noted that worker exposure investigations were conducted in 2009 and 2010 that may also provide useful information in understanding potential BNSF worker exposures.

DATA ADEQUACY EVALUATION

A determination of the adequacy of the achieved analytical sensitivity depends upon the detection frequency of asbestos structures. Uncertainty around an estimate of asbestos concentration in a sample is a function of the number of asbestos structures observed during the analysis; as this number increases, the relative uncertainty decreases. Thus, achieving the TAS is most important for datasets with a higher frequency of non-detects and low level structure counts (e.g., less than 5 structures). As noted above, all air samples collected in the OU6 2008 ABS study were non-detect; therefore, making sure that the achieved analytical sensitivity is adequate is of utmost importance to ensure reliable decision-making with respect to the new LA-specific toxicity values.

The level of analytical sensitivity needed to ensure that an air sample analysis will be adequate is derived by finding the concentration of LA in air that might be of potential concern, and then ensuring that if an air sample were encountered that had a true concentration equal to that level of concern, it would be quantified with reasonable accuracy.

The following describes the process for deriving the TAS needed to support decision-making with respect to the new LA-specific toxicity values.

Step 1: Calculation of Risk-Based Concentrations

Cancer. The basic equation for calculating the risk-based concentration (RBC) for cancer is:

RBC_c = Risk / (TWF_c * IUR_{LA})

where:

RBC_c = Risk-based concentration of LA in air for cancer, as PCM or PCM-equivalent (PCME) structures per cubic centimeters of air (s/cc).

Risk = Lifetime excess risk of developing cancer (lung cancer or mesothelioma) as a consequence of site-related LA exposure. For cancer, the maximum acceptable risk is a risk management decision. For the purposes of calculating the TAS, a value of 1E-05 is assumed.

TWF_c = Time-weighting factor for cancer. The value of the TWF term ranges from zero to one, and describes the average fraction of a lifetime during which exposure occurs from the specific activity being assessed.

TWF = ET/24 * EF/365 * ED/70 * AUF

where:

ET = Average exposure time (hrs/day)

EF = Average exposure frequency (days/year)

ED = Exposure duration (years)

AUF = Area Use Factor (fraction)

IUR_{LA}= LA-specific lifetime inhalation unit risk $(0.17 \text{ LA PCM s/cc})^{-1}$

Non-Cancer. The basic equation for calculating the RBC for non-cancer effects is:

$$RBC_{nc} = (HQ * RfC) / TWF_{nc}$$

where:

RBC_{nc} = Risk-based concentration of LA in air for non-cancer, as PCM or PCME s/cc.

HQ = Hazard quotient for non-cancer effects as a consequence of site-related LA exposure. For non-cancer, the maximum acceptable HQ is 1.

TWF_{nc} = Time-weighting factor for non-cancer. The value of the TWF term ranges from zero to one, and describes the average fraction of a lifetime during which exposure occurs from the specific activity being assessed. Note that the interval over which exposure duration is calculated is from age 0 to age 60. This is because the non-cancer toxicity factor is based on cumulative lifetime exposure lagged by 10 years.

$$TWF = ET/24 * EF/365 * ED/60 * AUF$$

where:

ET = Average exposure time (hrs/day)

EF = Average exposure frequency (days/year)

ED = Exposure duration (years)

AUF = Area Use Factor (fraction)

RfC_{LA}= LA-specific reference concentration. The draft RfC_{LA} is currently in the process of being revised. For the purposes of deriving the TAS, an RfC_{LA} of 0.00006 LA PCM s/cc is assumed.

<u>Step 2: Determining the Target Analytical Sensitivity</u>

The lower of the RBC_c and RBC_{nc} is used to derive the TAS. The TAS is determined by dividing the RBC by the target number of structures to be observed during the analysis of a sample with a true concentration equal to the RBC:

$$TAS = RBC / Target\ Count$$

The target count is determined by specifying a minimum detection frequency required during the analysis of samples at the RBC. This probability of detection is given by:

Probability of detection = 1 - Poisson(0,Target Count)

For the purposes of deriving the TAS, the target count is set equal to 3 structures (i.e., if the sample concentration is equal to the RBC, there is a 95% probability that an analysis that achieves the TAS will observe at least 1 structure).

The following table provides the exposure parameter assumptions used to derive the TAS using the procedures described above for each exposure population of interest for OU6:

Exposure Population	Exposure Time [ET] (hours/day)	Exposure Frequency [EF] (days/year)	Exposure Duration [ED] (years)	TAS (cc^{-1})
Worker	8 [(a)]	60 [(a)]	50 [(a,c)]	0.0004
Pedestrian Trespasser	4 [(a)]	60 [(b)]	50 [(a,c)]	0.0009
On-looker Trespasser	2 [(a)]	60 [(b)]	15 [(b)]	0.006

[(a)] As provided in the ABS SAP (ENSR/AECOM 2008)
[(b)] Assumed based on professional judgment
[(c)] Assumes individual is also a Libby resident

Based on the derived TAS specified in the table above, and in review of the achieved analytical sensitivities for the personal ABS air samples[2], supplemental TEM analysis is necessary for:

- all (14) of the worker samples,
- 8 of 14 pedestrian trespasser samples, and
- none of the on-looker trespasser samples.

ANALYTICAL REQUIREMENTS FOR THE SUPPLEMENTAL EVALUATION

All supplemental TEM analyses should be performed using counting protocols for recording phase contrast microscopy-equivalent (PCME) structures only (per ISO 10312 Annex E). That is, filters will be examined at a magnification of 5,000x, and all asbestos structures meeting PCME counting rules (i.e., having a length > 5 micrometers [µm], width ≥ 0.25 µm, and aspect ratio ≥ 3:1) will be recorded.

An analytical requirements summary sheet [**SUPPABSOU6-0413**], which details the specific preparation and analytical requirements associated with this supplemental evaluation will be reviewed and approved by all participating laboratories in this evaluation prior to any sample handling. A copy of this analytical requirements summary sheet is provided in Attachment A. The most recent version of this summary sheet is maintained on the Libby Lab eRoom.

The analytical requirements are specified in more detail below.

[2] Experience at Libby and at other asbestos sites has demonstrated that personal air samples are more representative of breathing zone exposures and tend to have higher concentrations of LA than samples collected by a stationary monitor, especially if the person is engaged in an activity that disturbs asbestos source materials. Thus, this evaluation focuses on personal ABS air samples.

Grid Preparation

For each sample, the laboratory will use a portion of the original archived air filter to prepare new grids, using the grid preparation techniques described in Section 9.3 of ISO 10312. Grids will be examined by TEM in basic accordance with the recording procedures described in ISO 10312, as modified by the most recent versions of Libby Laboratory Modifications LB-000016, LB-000029, LB-000066D, LB-000067, and LB-000085.

Analysis Method

All samples will be examined using counting protocols for recording phase contrast microscopy-equivalent (PCME) structures only (per ISO 10312 Annex E). That is, filters will be examined at a magnification of about 5,000x, and all amphibole structures (including not only LA but all other amphibole asbestos types as well) that have appropriate selective area electron diffraction (SAED) patterns and energy dispersive x-ray analysis (EDXA) spectra, and meet PCME counting rules will be recorded on the Libby-specific TEM laboratory bench sheets. If observed, chrysotile structures should be recorded in accordance with ISO 10312 recording procedures.

Stopping Rules

The analyst should continue to examine grid openings until one of the following is achieved:

- The TAS is achieved (see table above for the specific TAS).
- 25 PCME LA structures have been observed.
- A total filter area of 10 mm^2 has been examined (this is approximately 1,000 grid openings).

When one of these criteria has been satisfied, complete the examination of the final grid opening and stop.

Results Reporting

When reporting supplemental analysis results, the laboratory should utilize a new Libby-specific electronic data deliverable (EDD) spreadsheet for reporting TEM air results (i.e., new grid openings should NOT be appended to the bottom of the original EDD). In the new EDD, the laboratory sample ID should be assigned a unique ID from the original analysis or the ID should include an "S" suffix (to distinguish between the original and supplemental laboratory sample ID). On the supplemental analysis benchsheet(s), the analyst should specify that the analysis is being performed as part of a supplemental evaluation by inputting the achieved sensitivity from the original analysis in the appropriate field (see lower right corner of *Lab Sheet 1*). In addition, to avoid duplicating named grid openings in the supplemental evaluation, grid names should also include an "S" suffix (e.g., Grid A-S, Grid B-S).

REFERENCES

ENSR/AECOM. 2008. Rail Maintenance Public Receptor Activity- Based Sampling and Analysis Plan, Operable Unit 6. Libby, Montana, Superfund Site.

EPA. 2008. Framework for Investigating Asbestos-Contaminated Sites. Report prepared by the Asbestos Committee of the Technical Review Workgroup of the Office of Solid Waste and Emergency Response, U.S. Environmental protection Agency. OSWER Directive #9200.0-68. http://epa.gov/superfund/health/contaminants/asbestos/pdfs/framework_asbestos_guidance.pdf

ISO (International Organization for Standardization). 1995. Ambient Air – Determination of asbestos fibers – Direct-transfer transmission electron microscopy method. ISO 10312:1995(E).

ATTACHMENT 1

ANALYTICAL REQUIREMENTS SUMMARY SHEET

[SUPPABSOU6-0413]

SAP/QAPP REQUIREMENTS SUMMARY #SUPPABSOU6-0413
SUMMARY OF PREPARATION AND ANALYTICAL REQUIREMENTS FOR ASBESTOS

Title: Memorandum: OU6 Outdoor ABS Supplemental TEM Analysis Recommendations, Libby Asbestos Site, Operable Unit 6 (dated 4/26/2013)

EPA Technical Advisor: Dania Zinner (303-312-7122, Zinner.Dania@epa.gov)
(contact to advise on preparation/analytical requirements)

Sampling Program Overview: ABS air samples that were originally collected in 2008 will be re-analyzed by TEM (supplemental analysis) to achieve a lower analytical sensitivity.

Sample ID Prefix: BA- _ _ _ _

Estimated number of field samples:
>> ABS Air = 22 samples

TEM Preparation and Analytical Requirements for Air Field Samples:

Medium Code	Medium, Sample Type	Preparation Details [(b)]				Analysis Details[(f)]			Applicable Laboratory Modifications (current version of)
		Investi-gative?	Indirect Prep?		Filter Archive?	Method	Recording Rules	Analytical Sensitivity/Prioritized Stopping Rules	
			With Ashing	Without Ashing					
[(a)]	Air, ABS	Yes	--	--	Yes	TEM – Modified ISO 10312, Annex E *(Low Mag, 5,000X)*	All PCME asbestos[(c)]; L: > 5 µm W: ≥ 0.25 µm AR: ≥ 3:1	Count a minimum of 2 grid openings in 2 grids, then continue counting until one is achieved: i) the target analytical sensitivity is achieved[(d,e)] ii) 25 PCME LA structures are recorded iii) 10 mm^2 of filter has been examined	LB-000016, LB-000029, LB-000066D, LB-000067, LB-000085

(a) The medium code is not used to designate the target analytical sensitivity as it was in the original analysis; see the attached tables for a complete list of samples and their associated target analytical sensitivity.

(b) The laboratory will prepare new grids from a portion of the archived filter (see most current version of SOP EPA-LIBBY-08 for preparation details) to perform the supplemental analysis. During data entry, the grid names should include the suffix "-S" to indicate that they were part of the supplemental evaluation.

(c) If observed, chrysotile [CH] and other amphibole [OA] asbestos should be recorded.

(d) Target analytical sensitivity:
Pedestrian Trespasser ABS air samples - 0.0009 cc^{-1}
Worker ABS air samples - 0.0004 cc^{-1}

(e) The sensitivity achieved in the original analysis should be taken into consideration when determining the number of grid openings needed for the supplemental analysis. The Air/Dust TEM EDD (beginning with v38) has been revised to incorporate this functionality. A summary of the sample-specific sensitivities achieved during the original analysis can be found in the attached tables.

(f) The lab sample ID for the supplemental analysis should be modified to be unique from the original analysis (e.g., the suffix "S" should be added to the original lab sample ID or a new lab sample ID should be assigned). When reporting supplemental analysis results, the laboratory should utilize a new EDD spreadsheet for reporting TEM air results (i.e., new grid openings should NOT be appended to the bottom of the original EDD and no grid openings from the original analysis should be included in the supplemental analysis EDD).

Analytical Laboratory Quality Control Sample Frequencies:

TEM[(g)]:

Lab Blank – 4%	Verified Analysis – 1%
Recount Same – 1%	Recount Different – 2.5%
Repreparation – 1%	Interlab – 0.5%

(g) See LB-000029 for QC selection procedures and acceptance criteria.

Requirements Revision:

Revision #:	Effective Date:	Revision Description
0	4/26/2013	---

Analytical Laboratory Review Sign-off:

- ☐ EMSL – Libby [sign & date: _____]
- ☐ EMSL – Cinnaminson [sign & date: _____]
- ☐ EMSL – Beltsville [sign & date: _____]
- ☐ EMSL – Denver [sign & date: _____]
- ☐ ESAT [sign & date: _____]
- ☐ Hygeia [sign & date: _____]
- ☐ RESI [sign & date: _____]

[Checking the box and initialing above indicates that the laboratory has reviewed and acknowledged the preparation and analytical requirements associated with the specified SAP.]

ABS Air Sample Type	Sample ID	Achieved sensitivity (cc^{-1}) in the original analysis
Pedestrian Trespasser	BA-00032	0.000974
	BA-00033	0.00115
	BA-00051	0.0022
	BA-00041	0.00229
	BA-00050	0.0023
	BA-00062	0.00234
	BA-00061	0.00235
	BA-00040	0.00237
Worker	BA-00022	0.00224
	BA-00021	0.00231
	BA-00048	0.00231
	BA-00058	0.00232
	BA-00011	0.00233
	BA-00047	0.00233
	BA-00029	0.00235
	BA-00030	0.00235
	BA-00059	0.00236
	BA-00012	0.00239
	BA-00001	0.00211
	BA-00002	0.00426
	BA-00037	0.00769
	BA-00038	0.00319

Shaded samples were prepared indirectly; the supplemental analysis should be performed on the secondary filter.